NEURORADIOLOGY

Part II

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Diseases of CNS

- INTRACRANIAL TUMOURS
- INFLAMMATIONS
- HEAD TRAUMA
Imaging methods

- Plain film radiography
- Ultrasonography (US)
- Computed tomography (CT):
  - Conventional CT + contrast material
  - CTA
  - CT perfusion
- Magnetic resonance imaging (MRI):
  - Conventional MRI: different sequences, contrast material
  - MRA
  - MRS
  - DWI/PWI
  - fMRI
- Digital subtraction angiography (DSA)
INTRACRANIAL TUMOURS classification

Neuroimaging / histological diagnosis

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INTRACRANIAL TUMOURS - Characteristics

- Abnormal tissue growth: CT, MRI
- Altered vascularisation: perfusion, angiography
- Changed metabolism: MRS
- Contrast enhancement: CT, MRI + iv. contrast material
- Perifocal edema: CT, MRI, MRS
- Space-occupying effect: CT, MRI
- Hydrocephalus: CT, MRI
- Bone lesions: CT, MRI
- Multiplicity: CT, MRI
INTRACRANIAL TUMOURS

localisation

Mostly supratentorial
infratentorial

- Extraaxial
  • supratentorial
  • infratentorial

- Intraaxial
  • supratentorial
  • infratentorial
Abnormal tissue growth

- Structure:
  - Homogenous
  - Inhomogenous
    - calcification,
    - cyst,
    - necrosis
    - haemorrhage

- Border:
  - sharp
  - blurred
  - irregular e.g.
Changed vascularisation

Tumor vascularisation - CT/MR perfusion
- Increased CBV, CBF
- Dignity - CBV correlation +
- Increased permeability: enhancement
- Angio: vascularisation
Contrast enhancement

BBB

Structures without BBB
- Hypophysis and infundibulum
- Pineal gland
- Area postrema
- Dura (falx and tentorium)

Arteries, veins
Choroid plexus

Contrast Enhancement
- Extra-axial tumors: Meningioma, Schwannoma
- High grade gliomas
- Low grade gliomas: ganglioglioma, pilocytic astrocytoma
- Lymphoma
- Metastases
- Non-tumoral: infection, abscess, MS, infarction

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Contrast enhancement

• Non enhancing

• Enhancing (homogeneous, heterogeneous)

• Partly enhancing tumors

• Special signs: “tail sign”, closed-opened ring

• Malignity – cm enhancement correlation in a histological group +
Contrast enhancement

- Non enhancing
- Enhancing (homogeneous, inhomogeneous)
- Partly enhancing
- Special signs: "tail sign", closed or opened ring
- Malignity - c.m. enhancement
  + correlation in the same histological group
Changed vascularisation
MR perfusion
tumor/necrosis/oedema

Recurrant tumor

Radiation necrosis
Changed metabolism - MRS

Normal brain

Tumor

Cho=cellularity, NAA=neuron integrity, Lac=anaerob metabolism
**Changed metabolism-MRS**

- **MR spectroscopy:**
  - Tumor or not tumor
  - Tumor diff. dg
  - Grading
  - Define real extension
    - over enhancing lesion
    - inside oedema
  - Heterogeneity
  - Biopsy (localize most malignant parts—proper site of biopsy)
  - Effect of therapy
  - Consequences of therapy
    (radiation necrosis or recidive tumor)
Edema

Tumor vs. ischaemic lesion

Peritumoral, vasogenic type

Ischaemic, cytotoxic type

Fingerlike

WM

WM+GM

Vascular supplying territory
Space-occupying effect, herniations

Edema + tumor

- increased intracranial pressure
  - compression/dislocation
  - herniations
    - subfalcine,
    - transtentorial,
    - transforaminal
Hydrocephalus

- Increased CSF production
  - CSF producing tu.
  - plexus papilloma
- Impaired CSF resorption
- Impaired CSF circulation

Balance disruption
Circulation impairment
Hydrocephalus

- Increased CSF production
- Impaired CSF resorption
  - SAH
  - Meningial processes
    - Meningeal metastasis
    - Haematological tu.
    - Inflammations
- Impaired CSF circulation
Hydrocephalus

- Increased CSF production
- Impaired CSF resorption
- Impaired CSF circulation
  - Midline tumors
    - Medulloblastoma
    - Pineal region tu.
Bone changes

- Lytic
- Sclerotic
- Atrophic
- Destructive
- Remodelling
Physiological calcifications

- Choroid plexus
- Basal ganglia
- Pineal gland
- Falx
Pathological calcifications
Pathological calcifications
Multiplicity

- Metastases
- Glioblastoma
- Lymphoma
- Non-tumor diseases
Tumor vs cyst

- Epidermoid, arachnoid cyst
  - CT, conventional MRI non-conclusive

- DWI/FLAIR:
  - Epidermoid: hyperintensive to CSF
  - Cysta: isointensive with CSF
Tumor vs abscess

- Necrotic tumor, abscess
  - CT, conventional MRI
    inconclusive

- DWI:
  - Necrotic tumor content
    hypointensive
  - Abscess content
    - Hyperintensive
  - Restricted diffusion
fMRI for surgical planning
Left temporal tumor relationship to the speech centres

Patient gets instructions
form words
move fingers
Certain areas of brain get activated

Zoccatelli et al, 2013
Diffusion tensor tractography

Idris et al., 2013
Preoperative MR angiography

Meningioma:
- relationship to the vessels
- surgical exploration planning
**Meningioma**

- Extraaxial
- Supra-, infratentorial
- Convexity, basal, intraventricular
- Meningeal origin
- Meningeal artery supply
- Calcification
- Bone changes
- Homogeneous/inhomogenous enhancement
- Tail sign
Astrocytoma Gr I-III

- Intraaxial
- Supra-, infratentorial
- Glial origin
- Grade I-IV
- Contrast enhancement ~ dignity
- CBV ~ dignity
- Cyst, calcification - benign
- Necrosis - malignant
Astrocytoma Gr I
Pilocytic astrocytoma

Impaired CSF circulation
Transependymal migration of CSF into the brain parenchyma
Transforaminal herniation
Oligodendroglioma

Calcification
Enhancement +/−
Astrocytoma Gr IV
Glioblastoma

- Supra-, infratentorial
- Necrosis
- Irregular ringlike enhancement
- Highly malignant
- Butterfly tumor
Optic glioma
NF.I.
Hypophysis adenoma

with/without hormon production
Medulloblastoma

- Infratentorial
- Highly malignant
- Drop metastasis
Ependymoma
Metastasis

- Lung, breast, GU, melanoma, GI, Ly
- Multiple
- Ring enhancement
- Calcification – colon tu
Multiple metastasis

Vasogenic oedema
Metastasis

Cranial nerves exit the skull through foramina.
Cranial nerve palsy.
Diseases of CNS

INFLAMMATIONS

- Viral
- Bacterial
- Fungal
- Parasitic
- Immune-mediated
- Others

- Brain parenchyma
  - encephalitis
  - cerebritis, abscess
  - multiple sclerosis
- Meninges
- Vessels
- Bones
INFLAMMATIONS

- Brain parenchyma
  - encephalitis
    - herpes encephalitis
  - cerebritis, abscess
  - multiple sclerosis
- Meninges
- Vessels
- Benes
INFLAMMATIONS

- Brain parenchyma
  - encephalitis
  - cerebritis, abscess
  - multiple sclerosis
- Meningitis
- Vasculitis
- Osteomyelitis

Restricted diffusion - mobility protons
INFLAMMATIONS

• Brain parenchyma
  - encephalitis
  - cerebritis, abscess
  - multiple sclerosis
    • Perpendicular to the lateral ventricles
INFLAMMATIONS

- Brain parenchyma
  - encephalitis
  - cerebritis, abscess
  - multiple sclerosis

- Meningitis
  - Complications:
    - hygroma
    - abscess formation
    - Hydrocephalus (CSF resorption)
    - Thrombosis (arterial, venous)

- Vasculitis

- Osteomyelitis
INFLAMMATIONS

• Brain parenchyma
  - encephalitis
  - cerebritis, abscess
  - multiple sclerosis

• Meningitis
  - Complications:
    • hygroma
    • abscess formation
    • Hydrocephalus (CSF resorption)
    • Thrombosis (arterial, venous)

• Vasculitis
  - (ischemic lesion, bleeding)

• Osteomyelitis
The most important step in evaluation for head trauma different windows are used

1: brain w.-brain parenchyma
2: intermediate w.-make visible little subdural and epidural heamatoma
3: bone w.-determine the presens or absense of bony fracture
Sometimes valuable than CT for following
1: shows non-haemorrhagic parenchymal lesions
   DAI
   contusion
2: higher sensitivity in the subacute and chronic stage
3: follows CT when CT does not resolve the nature of brain injury
Diseases of CNS

TRAUMA

• Closed head trauma (intact dura)
  - epidural haematoma
  - subdural haematoma
  - contusion
  - oedema
  - hydrocephalus

• Open head trauma (dural tear)
  - impression fracture
  - pneumatocele
  - foreign body
  - haematoma, edema
  - secondary infection

CT
Diseases of CNS

TRAUMA

- epidural haematoma
- subdural haematoma
- SAH
  - Outer layer of dura adheres to the periosteum of the bones
Closed head trauma
Diseases of CNS

TRAUMA

- Closed head trauma (intact dura mater)
  - epidural haematomata
  - subdural haematomata
    - acute - hyperdense
    - subacute - isodense
    - chronic - hypodense
  - SAH
- contusion
- edema
- hydrocephalus
Closed head trauma - DAI
Diseases of CNS

TRAUMA

• Open head trauma (dural tear)
  - impression fracture
  - pneumatocele
  - foreign body
  - haematoma, edema
  - secondary infection
Diseases of CNS

Late posttraumatic lesions - MRI

Chronic encephalomalacia
epileptic focus
Atrophy
Hydrocephalus